SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, AUGUST 4, 1905.

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RECENT ADVANCES IN PHYSIOLOGICAL CHEMISTRY.[1]

THE enormously rapid development of physiological chemistry in the last ten years may be well illustrated by a consideration of the new journals which have been found necessary to publish the increasing literature, and also by the influence which this department of science is exerting on other sciences, particularly on medicine. For twenty years the *Zeitschrift für physiologische Chemie* and *Maly's Jahresbericht* were sufficient to represent the specialty, which had been considered a somewhat narrow one, but suddenly, and almost simultaneously, three other publications were called into existence to keep pace with the newly aroused interest. These are the *Biochemisches Centralblatt,* the *Beiträge zur chemischen Physiologie und Pathologie* and the volume on Biochemistry of the *Ergebnisse der Physiologie,* all since 1902.

Several causes have worked to bring about this situation and the most important will be touched on in what follows, but at the outset two things are apparent; on the one hand, there is the stimulating influence of pure organic chemistry, and on the other the requirements of physiology and pathology for a more rational chemical foundation. This last factor is an extremely potent one; some of the most interesting problems of physiological chemistry have been suggested by questions growing out of the discussion of the modern doctrines of immunity and the causation of disease.

It follows, therefore, that many of the advances in physiological chemistry are in lines which are comparatively new, but there are some noteworthy exceptions and of one of these I wish to speak first. This is concerned with the question of protein

[1] Read at Buffalo meeting of the American Chemical Society, June 22, 1905.

in nutrition which has been a much debated problem for fifty years. Indeed, interest in this goes back to the days of the epoch-making publications of Liebig on the relation of organic chemistry to physiology and pathology, issued in the early forties. In these he developed his idea of the functions of various foods in the nutrition of man and laid particular stress on the importance of protein as the source of muscular energy. According to this early Liebig view our foods may be divided into plastic or tissue-forming, on the one hand, and heat-producing, on the other. The production of heat appeared as an end in itself and the fats and carbohydrates served for this purpose. The protein substances are built up into tissues and in the oxidation of the latter, it was held, we have the sole source of muscular energy. The name of Liebig was all-potent in science in those days and his nutrition theory held sway for twenty years or more without question. It will not be necessary to recount the steps in the opposition which finally developed, but it may be well to recall the famous experiment of Fick and Wislicenus in which, in an ascent of the Faulhorn, in 1866, they calculated the work done and the protein oxidized, as measured by the urea excretion. The protein combustion was found to be far too little to account for the expenditure of work in the climb, which result confirmed the theoretical objections urged, especially by J. R. Mayer, of Heilbronn. Other important investigations followed in the same direction, and almost without exception they have gone to show that while the protein oxidation *may* furnish a part of the muscular energy of the body, or even all of it under certain extreme circumstances, the fats and carbohydrates are the usual sources of such energy in man, and that heat production is only incidental, not an end, but an unavoidable accompaniment. A few recent experiments which have seemed to support the Liebig contention have been made largely with carnivorous animals and have no real bearing on the problem as far as man is concerned.

As a necessary consequence of the Liebig theory it was held that our protein consumption must be high, and hence the large amounts of nitrogenous substances insisted upon in the older dietaries. But after a time physiologists naturally began to inquire into the real uses of protein, if it is not called for in the work of the muscles; if, as appeared evident, it is used mainly in the repair of waste tissues, why metabolize so much, since in this metabolism an enormous amount of extra work is thrown on the oxidizing and excreting organs of the body. It certainly can not be assumed that the disposal of the katabolic products of proteins can be accomplished without using up a considerable amount of energy, and without a great strain on the liver and kidneys. What, then, is the amount of protein actually needed for the normal body? Numerous answers have been given to this question and in late years several investigations have apparently brought the daily protein down to 25 to 40 grams, or even lower. But it has been urged against all the experiments leading to such results that they were of too short duration to actually prove anything of value. For example, Siven carried out a 32-day test in which the protein metabolized daily was about 38 grams; during a part of this time the body was kept in nitrogen equilibrium by about 25 grams daily. Hirschfeld somewhat earlier had made numerous observations in which the protein consumption through about two weeks was 35 to 45 grams, but fats and carbohydrates brought the diet up to an equivalent of 3,750 to 3,900 calories.

The importance of the subject is worthy of the fullest investigation, and such a

study has finally been carried out by Chittenden through experiments, first on himself, and then on groups of men engaged in various occupations. In the first of these remarkable experiments, which have recently been described in book form under the title 'Physiological Economy in Nutrition' the distinguished Yale scientist determined in his own case how far he could safely reduce the protein of his diet and still retain the body in nitrogen equilibrium. To do this close watch was held on the food and excreta through a year, November, 1902, to October, 1903, and under varying external conditions of work and temperature. As a result of these systematic tests Chittenden found that he could live very comfortably, and in perfect health, on a diet containing 35 to 40 grams of protein daily, with fats and carbohydrates sufficient to yield 1,500 to 1,600 calories. These valuable personal experiments were regarded as preliminary only. Later, systematic observations were made with three groups of men, the work being carried through periods of five to nine months for each group.

The first group comprised colleagues of the author of the experiments, Yale professors and instructors. The average protein metabolism here was about 46 grams. The second group was composed of soldiers from the hospital corps of the United States army who were detailed for the purpose of the study. Of the twenty who began, thirteen followed the tests through the whole period of over six months. Those who deserted, or were dropped, had much to say through the newspapers about starvation diet, but this was a curious misnomer, since, as the records show, the men who remained were kept in perfect nitrogen equilibrium and found themselves in far better physical condition at the end of the experiments than at the beginning. Through all this time they had plenty of work to perform, with constant and rather severe requirements on the muscular system. The average protein consumption daily was not far from 55 grams.

Finally, eight Yale athletes showed themselves willing to work through the training and competing season on the restricted protein diet. The results here were equally remarkable, in fact probably the most remarkable, as the work done by these men was of a character to call for very high protein diet according to all of our old standards. The experiments were carried out through a period of five months, February to June, 1904, and through the last two months a very close record was kept of diet, excretion, weight and various other factors concerning the men. Through this sixty-day period, when the muscular exertion was, perhaps, the most taxing, protein equilibrium was maintained on an average of 8.81 grams of nitrogen metabolized for each man daily, corresponding to about 55 grams of protein. All these men took high rank in athletic work, several of them being prize winners. The reproductions of photographs, published in the book, show them to be men of excellent physique, and even of remarkable muscular development in some cases. While the protein diet of these men was low the fat and carbohydrates were generous but not excessive, the calorific value of the whole being seldom over 3,000 calories.

For all these men under examination in these three sets of tests, professional men, soldiers, athletes, complete statistics for each day are published, from which the reader may derive the fullest possible information. Painstaking accuracy is evident in every page, and from the standpoint of logical requirement in experimental proof the tables meet any reasonable objection.

This Chittenden investigation then must

be regarded as of fundamental importance, as it demonstrates beyond cavil just what is possible in protein restriction under ordinary conditions. The periods of investigation chosen were long enough to answer objections to the results of some of the earlier tests, and the values obtained for the soldiers and athletes of about 55 grams of protein metabolized daily will have to be taken as practical standards. It doubtless remains true that for men at severe work at low temperatures a large number of calories are required in the food. An instructive example of such dietaries is given in the recent publication by C. D. Woods on the diet of Maine lumbermen, where it is shown that the heat value of the food consumed daily by men in the lumber camps may amount to 6,000 or 8,000 calories. It would be interesting to experiment in such cases on the replacement of a good share of the protein by fat and carbohydrates.

A study of the Chittenden series of experiments on men shows very clearly that as far as the human organism, at any rate, is concerned the old Liebig notion of the source of muscular energy is without foundation. As suggested above, experiments with carnivorous animals do not apply to man; it would be as justifiable to discuss the food value of pentoses for man from experiments on the feeding of straw to cattle. It is true that for short periods, or under special conditions, proteins may serve man as the main or only source of muscular energy, but evidently this is not usually or normally the case.

When the far-reaching importance of the whole question is realized, and when it is further remembered that considerable internal work must be done to remove, especially, the products of protein metabolism, I believe it will be granted that I am right in placing this work of Chittenden among the most important recent achievements in physiological chemistry.

The next topic of which I wish to speak very briefly deals with a problem even older than that of the Liebig theory of the source of muscular energy. Some years before the organic chemistry of Liebig was published Mulder had introduced the term protein, and had even announced the essential composition of what he considered the protein nucleus. His positive statements led to extended investigations on the part of others, and the work of many chemists soon disclosed the fact that no one simple nucleus may be assumed to exist in these molecules and that they must be enormously complex. Ever since the early forties the problem has been an extremely interesting one, but it is only recently that it has been seriously attacked from the second side possible in such investigations. Up to a period within five years the work done on the protein question has been largely in the way of analysis or disintegration, but now we have the beginning of attempts at synthesis or reconstruction of large groups. Glycine and leucine had been known since about 1820 as decomposition products of glue and other bodies by action of acid. Nearly thirty years later tyrosine was added as obtained in about the same way, and soon a few other individual substances were listed among the products which could be secured in various decompositions of proteins. In the seventies systematic methods of hydrolysis by alkalies and acids were worked out, especially by Schützenberger and Hlasiwetz and Habermann. Numerous products were recognized, but at first these attracted no great attention, as there remained always the possibility that the amino acids and other compounds found might be results of secondary reactions. We can not infer much regarding the structure of soft coal from the presence of methane in the gas, or of benzene, tolu-

ene and naphthalene in the tar, and an analogous proposition may be true for the proteins. Later, however, this important generalization was reached; it matters little how the decomposition is effected, the products of protein destruction are essentially the same as long as brought about in the presence of water, and all seem to be in the nature of hydrolytic cleavages. The action of boiling acid or alkali, steam under pressure, pepsin and hydrochloric acid, trypsin and weak alkalies, all lead to nearly the same resultant products, and among these certain α-amino acids are always the most abundant. The conclusion follows, therefore, almost of necessity, that these are the true nucleus groups and the question naturally suggests itself, is it possible to put these things together and build up anything like a true protein. An answer to the question has been slow in coming, but a beginning has been made, and especially through the experiments of Curtius and Fischer. The condensation method followed by the former is a general one, through which a large number of amino groups have already been combined. It depends first on the production of hydrazides, then azides, which are very reactive, and take on additional amino groups with loss of hydronitric acid. For example, the ethyl ester of hippuric acid condenses with hydrazine hydrate to form the hydrazide:

$$C_6H_5CO \cdot NHCH_2CO \cdot NH \cdot NH_2;$$

this with nitrous acid gives the azide

$$C_6H_5CO \cdot NHCH_2CO \cdot N_3.$$

By treatment with glycine under certain conditions this reaction follows:

$$C_6H_5CO \cdot NHCH_2CO \cdot N_3 + NH_2CH_2COOH = N_3H + C_6H_5CO \cdot NHCH_2CO \cdot NHCH_2COOH.$$

In other words, we have started with benzoylglycine and have obtained benzoylglycylglycine. This in turn may be used as a new starting point. A silver salt is made, this turned into ester with ethyl bromide, and then a new hydrazide and azide to be combined with glycine, as before. These steps will lead to benzoyl diglycylglycine, and by using alanine, leucine or other amino acid it will be seen that by repeating the processes extremely complex groups may be finally built up. Curtius has carried the reaction to the formation of benzoyl hexaglycylglycine,

$$C_6H_5CO \cdot (NHCH_2CO)_6NHCH_2COOH.$$

Hippuryl and three alanine groups have also been condensed to form benzoyl glycyldialanylalanine.

Fischer has worked from a different standpoint. The study of various hydrolytic products from proteins, already referred to, and the isolation of certain other groups by Fischer himself, led to the belief that the complex molecules in the proteins must be built up by the union of amino acid groups. Various attempts had been made to condense some of the simple amino acids in anhydride form, but without much success, until the first experiments were made by Fischer in 1901. The starting point of the series of condensations was found in the product obtained from the glycine anhydride described in 1888 by Curtius and Goebel. This may be looked upon as formed by the union of two molecules of glycine with loss of two molecules of water, and when digested with strong hydrochloric acid suffers a peculiar decomposition and yields a body to which Fischer has given the name glycylglycine.

$$\begin{array}{l} CO \quad OH \quad H\,HNCH_2 \\ | \qquad\qquad\quad | \\ CH_2NH\,H \quad HO\,OC \end{array}$$

$$\begin{array}{l} CO \cdot CH_2 \cdot NH \\ | \qquad | \\ NH \cdot CH_2 \cdot CO \end{array} + H_2O = NH_2CH_2CONHCH_2 \cdot COOH$$

Glycylglycine may be considered as the first anhydride of glycine and is the characteristic group in the hippuryl glycine

from which Curtius has made the derivatives referred to above. In the same connection Fischer explained that a similar reaction follows with the anhydrides of alanine and leucine, from which alanylalanine and leucylleucine must result. To carry the process farther and obtain more complex groups proved practically difficult. Another method was finally developed which may be illustrated by some of the simplest cases described by Fischer. On bringing together a halogen acid chloride, for example chloracetyl chloride, with an ester of glycylglycine, chloracetylglycylglycine ester results,

$$ClCH_2CO \cdot NHCH_2CO \cdot NHCH_2COOC_2H_5,$$

which on saponification yields the acid. The latter in turn when treated with strong ammonia gives up chlorine for the amino group and diglycylglycine results. With α-brompropionyl bromide employed as the halogen compound, alanylglycylglycine is obtained, and with α-bromisocapronyl chloride leucylglycylglycine is secured in the same manner.

It will be seen that while the processes of Fischer and Curtius follow different lines they lead usually to the same ends. A considerable number of the Curtius investigations have been published in Vol. 70, N. F., 1904, of the *Jour. prakt. Chem.* under the title of 'Condensations of Amido Acids,' while the Fischer work has come out in recent volumes of the *Berichte* under the general title of 'Syntheses of the Polypeptides.' This work seems to be more directly concerned with the building up of bodies of physiological interest; the Curtius work is somewhat more general. Of many of the Fischer compounds it has been shown that ready hydrolysis with active pancreatic juice follows. The biuret reaction is also given in many cases, but apparently not always. Groups containing tyrosine, cystin, leucine, alanine, etc., have been split by the ferments, and these, it will be remembered, are among the most important of the fractions secured by the hydrolysis of the true proteins. The method of producing these polypeptides seems to be without limit and doubtless much more complex aggregations will be secured. Molecular weights of over 500 have already been reached.

Closely related to the question of the synthesis of the polypeptides is that of the composition of the simplest proteins. The work of Kossel and others in this direction has furnished most interesting results. For several of the protamines and histones the content of hexone bases has been found with a fair degree of accuracy, and of many of the more complex proteins the amounts of both mono- and diamino acids present have been found. The numbers secured must be looked upon, however, as minimum values because of the practical difficulties in the way of quantitative separation and identification.

Several improved processes have been developed for the separation of amino acids from digestion or other mixtures. A method first suggested by Curtius for the production of ethyl esters of the amino acids, and which has been referred to above, has been perfected by Fischer. From mixtures the esters are distilled off under greatly reduced pressure. From the distillate some are separated by solvents, while others, after conversion to acids, are separated by fractional crystallization. It has been found that β-naphthalene sulphochloride combines with many of the amino acids to form compounds of very slight solubility and Fischer and Bergell have developed a method of separation based on this fact. Both general methods have been applied also in the detection and estimation of amino acids in urine which is likely to become a matter of considerable clinical in-

terest, as these acids must represent degenerative or otherwise abnormal products having their origin in the liver and other organs.

Unquestionably one of the most important fields of effort in physiological chemistry at the present time is the study of the soluble ferments, and we have here for consideration not only certain newly discovered enzymes, but, perhaps, of more importance, a great advance in our knowledge of those already known. It was not many years ago that we considered the question of the gastric enzymes as practically settled. The presence of both pepsin and rennin no one could have doubted, but the work of Pawlow and his school in the last five years has thrown entirely new light on the subject and it would appear that one and the same ferment, working under different conditions, is responsible for both classes of observed phenomena. Pawlow has compared the digesting and milk curdling power of ferment secretions from the true pepsin and pyloric glands of the stomach, from the pancreas and from Brunner's glands, and has found them perfectly parallel under proper conditions of experiment; any cause which operates to destroy one power, destroys also the other according to Pawlow. But in any given extract or preparation the conditions must be properly chosen to show both effects. A commercial rennet, for example, may exhibit the milk curdling action very strongly, yet appear to be wholly inert toward fibrin. Pawlow holds that in all such cases simple dilution with very weak hydrochloric acid is all that is called for to show the peptic power. A valuable résumé of this work is given in a recent number of the *Zeitschrift für physiologische Chem.* (Vol. 42, p. 415, 1904).

It is proper to say that the physiologists of the Hammarsten school do not admit the claims of Pawlow, although the doctrines of the latter have been put in very strong light.

To Pawlow we owe, also, the discovery of a new group of ferments which he calls kinases, or activators. The most thoroughly studied of these is the enterokinase which converts the inactive pancreatic juice into an active ferment secretion. As to the value of the other kinases much less is known.

About four years ago Cohnheim described, under the name of erepsin, a peculiar ferment in the intestinal walls which has the power of splitting peptones and proteoses, but not albumins. This discovery grew out of an investigation to determine the fate of the peptone bodies of proteolysis, it being long known that no appreciable amount of these substances appears in the circulation after digestion. A theory grew up to the effect that in the intestinal walls, just before absorption, they were converted back into true albumins. According to the views now advanced by Cohnheim and others this can not be the case to any large extent. The peptones break down with liberation of the carbon and hydrogen excess, which serves as a source of energy, while the nitrogen fractions go over into the form of amino acids, to be further broken down by the liver. This coincides with the view that very little protein is actually needed by the body. On the other hand, it is held by several physiologists that the erepsin katabolism does not go so far, but merely to the production of amino compounds which are ready for a synthesis not yet understood.

If time permitted I should like to go into the question of enzymes in other directions, especially with reference to the work in the liver and the action of the so-called autolytic ferments, the behavior and general importance of which are still very ob-

secure. A large and interesting literature has grown up around the discussion. A word must be said, however, about the important discussion started two years ago by Cohnheim when he announced the relation of two distinct ferments to the oxidation of carbohydrates in the body. The bearing of this on the question of diabetes was immediately recognized and numerous investigations were launched to throw more light on the subject. According to Cohnheim the pancreas furnishes one of these enzymes and the muscle substance the other. One may serve as a kinase or activator for the other and the effect of the two is to facilitate oxidation in the muscles. The subject is immensely important, but the latest studies do not seem to fully confirm all the Cohnheim statements.

In connection with the subject of enzymes reference must be made to the considerable number of papers which have appeared in the last few years on the question of the relation of the ferments to the simple inorganic katalytic agents. Beginning with the work of Tammann published in the *Zeitschrift für physikalische Chemie* many attempts have been made to express the velocity of enzyme reactions by equations analogous to those suggested by Wilhelmy for the inversion of sugar. The extended investigations of Tammann led in general to formulas which were more complicated than those corresponding to the simple logarithmic curve. Some of the more recent work, especially that of Henri, has led to more definite results. This whole discussion has been well reviewed by Bredig in volume 1 of the *Ergebnisse der Physiologie*.

One of the most interesting developments in recent physiological chemistry is in the discussion of theories of immunity and the relations of toxins and antitoxins. As first presented by Buchner, Bordet, Ehrlich, Pfeiffer and others, these doctrines appeared from the chemical standpoint wholly visionary and intangible, but in the last few years a great change has followed in the attitude of chemists and now some of the phrases of the immunity theory of Ehrlich have become part of the language of organic chemistry.

It was early recognized that toxins and antitoxins act on each other in a manner suggesting combinations in definite chemical proportions, and attempts were soon made to work out the laws of the union. The earlier Ehrlich experiments seemed to point to simple combinations like those between an acid and a base, the union following to complete saturation. It was recognized later, however, in many cases, that the reaction is not complete and that the saturation curve is far from being a straight line. These observations led to various speculations. Ehrlich assumed that in the ordinary toxin mixtures we have certain modified forms known now as toxoids and toxons, which, while non-toxic, have saturating power resembling that of the toxins. Hence the amount of antitoxin added to a toxin solution to destroy its toxicity would have to be sufficient to combine, not only with the real toxin, but with any toxoid or toxon present also; just as in neutralizing free sulphuric acid by sodium carbonate the amount of the latter necessary would have to be increased if some salt decomposable by sodium carbonate, such as alum, is likewise present. In the one case as in the other the simplicity of the reaction would be obscured by complexity of the mixture.

Arrhenius and Madsen, and others following them, have been led also to study these extremely important phenomena and have given a different interpretation. According to the notions of the physical chemists these reactions are more or less per-

fectly reversible, which certain experiments seemed to prove, and resemble somewhat the union of an alcohol and an acid which combine to reach a condition of equilibrium. They assume for the toxin-antitoxin reaction the perfect applicability of the Guldberg-Waage mass action formulas, and for a number of relations have calculated the value of the constant k. It is interesting to note that a number of the leading physical chemists have taken part in the discussion. About a year ago Michaelis reviewed the subject in a long article in the *Biochemisches Centralblatt* and this has recently appeared in expanded book form under the title, 'Die Bindungsgesetze von Toxin und Antitoxin.' Michaelis does not accept the Arrhenius work as satisfactory or convincing, and points out several conditions necessary for the applicability of the mass action laws which do not obtain in the cases in question; for example, the mixtures are not homogeneous and the degree of reversibility is extremely limited, if it really exists.

On the other hand, the doctrine of the toxoids and toxons appears to explain the apparent discrepancies and in certain mixtures secured in the experiments of Keyes and Sachs, known to be free from these bodies, the toxin and antitoxin combination followed in proportions represented by an almost perfect straight line.

It remains to add that this whole discussion can not fail to have an important influence on the attitude of medical men to the rapidly developing physiological chemistry. The Arrhenius theory seemed to simplify the question somewhat and make it one of analogy with other well-known phenomena. The facts more recently adduced by the Ehrlich workers do not seem to permit this theoretically preferable solution. The toxoid and toxon hypotheses are necessarily chemical, however, and for the present may better serve in the advance of investigation.

J. H. LONG.
NORTHWESTERN UNIVERSITY MEDICAL SCHOOL,
CHICAGO, ILL.

SCIENTIFIC BOOKS.

The Evolution of Man. By ERNST HAECKEL. Translated from the fifth German edition by JOSEPH MCCABE. 2 vols., 8vo. New York, G. P. Putnam's Sons. 1905.

In the two stately and richly illustrated volumes before us we have a translation of the fifth edition of Haeckel's 'Anthropogenie,' and coming as they do from the pen of one who may now be regarded as a Nestor of zoology and the most vigorous exponent of the historical method of investigation, they present not a little interest. They profess to give in their course of some nine hundred pages an account of the embryological and comparative anatomical evidence bearing on the origin of man, a subject of perennial interest not only to the laity, but also to professional zoologists, since it involves the problem of the origin of the vertebrates.

The work opens with a chapter upon the biogenetic law, or, as it is termed, 'the fundamental law of organic evolution,' and then follow five especially interesting chapters devoted to a history of the development of embryology and phylogeny. To these succeed an extended account of the principal embryological stages of the vertebrates and a discussion of their significance, in which the germ cells, segmentation, gastrulation, the germ layers, metamerism, the fetal membranes and the development of the general form of the body, are all considered from the standpoint of their bearings on the ancestral history. This completed, the author passes on to a consideration of the recent representatives of the ancestral stages and concludes with several chapters devoted to the phylogeny of the various organs of the human body.

It would require much space to consider adequately the entire contents of the volumes, and the purpose of this review will, perhaps, be best served by indicating briefly the line of descent which Haeckel advocates. It is essentially the same as that presented in earlier

editions, of which the third has appeared in an English translation, but differs in the greater detail and precision with which the various stages are defined.

It starts with the Monera, non-nucleated masses of protoplasm which 'stand exactly at the limit between the organic and the inorganic worlds' and have originated by spontaneous generation. Of these, two varieties existed, differing in their physiological activities; the one group, the phytomonera, being plasmodomous, building up protoplasm from unorganized material, and the other, the zoomonera, being plasmophagous, finding their nutrition in already organized material. The phytomonera were the more primitive of the two, the zoomonera arising from them by metasitism or metatrophy, the reversal of the mode of nutrition, a process which may have occurred several times independently and among cytodes as well as moners. Hence not only have zoomonera been derived from phytomonera, but nucleated unicellular plasmophags have arisen from similar plasmodomes, and so Haeckel takes as his second stage of the ancestry the Algaria, represented to-day by such unicellular algæ as the Palmellaceæ. From these he derives the third stage, that of the Lobosa, represented by Amœba and having corresponding to it the ovum stage of ontogeny.

The line of descent is then traced through the moræa, blastæa and gastræa, familiar to all readers of Haeckel's writings, and then passes to the Platodaria and Platodinia, two groups of turbellarian worms represented to-day by the so-called Acœla and the Rhabdocœla. The ninth stage is that of the Provermalia, represented by such recent forms as the Rotatoria and Gastrotricha, and presenting an advance upon preceding stages in the possession of a body cavity and an anal aperture; and to these succeed the Frontonia, a group which many will regard as decidedly heterogeneous, since both the Nemerteans and the Enteropneusta are regarded as being its modern representatives. Then follows the Prochordonia stage, characterized by the possession of a definite notochord and branchial slits and by the absence of a well-defined metamerism; its nearest representatives among recent forms are the copelate ascidians and the appendicularia larvæ.

Haeckel thus omits metamerism as a fundamental and primitive condition whose existence in several groups of animals implies a community of descent; for him it is merely a mode of growth and as such has been independently acquired in different phyla. He regards the metamerism of the annelids and arthropods as something quite different both structurally and phylogenetically from the metamerism of the vertebrates, and consequently excludes the annelids from the line of descent.

The next stage ushers in the vertebrate phylum and is that of the Prospondylia, which finds its modern representative in the larval *Amphioxus,* and then succeeds a stage corresponding to the adult *Amphioxus,* then the Archicrania, represented by the Ammocœtes larva, and then a stage corresponding to the adult cyclostome. The line then passes through the Proselachii, Proganoidea and Palædipneusta, thence through the stegocephalous Amphibia to the Proreptilia represented most nearly by the modern Hatteria, and so to the Monotremes, which represent the Promammalian stage. Then follows the Prodidelphian stage and then that of the Prochoriata or Mallotheria, represented by an extinct group of placental mammals which included the stem-forms of the rodents, ungulates, carnivores and primates and, perhaps, finds its nearest recent representatives among the Insectivora. From the older Mallotheria the Prosimiæ are descended and of these Haeckel recognizes two ancestral stages, the Lemuravida and the Lemurogona, both belonging to Eocene times. From these the Simiæ with a true discoidal placenta are descended, but a discrepancy occurs between the general text, which is identical with the earlier edition in passing directly to the catarrhine forms, and the table given on p. 551, in which the line of descent is taken through primitive platyrrhines and thence through the Cynopitheca. However, the

twenty-eighth stage is that of the Anthropoides, most closely approached by Hylobates among recent forms, and then succeeds the Pithecanthropi or Alali, which included forms similar to, but not identical with, the gorilla and chimpanzee and finally, as the thirtieth stage, comes man.

Without attempting either a general or particular criticism of such a scheme, it may be said of the work that while clearly and interestingly written, it will hardly carry conviction to the mind of the reader. The gaps in the plan are too evident and too lightly passed over; conflicting theories, if mentioned, are treated too summarily; similarities between forms are frequently exaggerated; and, in short, the entire tone of the work is too dogmatic to be convincing. Sentences such as the following are by no means rare: 'In their first stage of development * * * the embryos of all the vertebrates, from the fish to man, are only incidentally or not at all different from each other,' 'Comparative evolution leads us clearly and indubitably to the first source of love—the affinity of two different erotic cells, the sperm cell and ovum (*erotic chemotropism*).'

On the other hand, one looks in vain for many facts which would have added strength to the general argument, and especially is this so in the chapters dealing with the phylogeny of the organs. Much that is highly pertinent has been omitted from the chapters on the muscular and nervous systems, and it is disappointing to find merely a mention of the recent important researches of Schwalbe and Klaatsch on the Neanderthal and Pithecanthropus remains.

But, notwithstanding these imperfections, the book is exceedingly interesting and contains a wealth of information on the questions under discussion. One can not help feeling, however, that it would have gained in value and authority if it had been limited to a discussion of the more general question of the descent of man, without attempting to define some thirty ancestral stages. It is especially in connection with the details that the dogmatism offends.

Finally, it may be remarked that it is unfortunate that more care has not been taken with the translation and proof-reading, in the latter especially with regard to proper names. Thus one finds Dreisch for Driesch, Moll for Mall, Ralph for Rolph, Dalton for D'Alton and Wiederscheim. Numerous terms are employed in the translation which are unfamiliar to English-speaking zoologists, and so much so as to indicate a lack of familiarity with the science on the part of the translator. It is possible to recognize the earthworm in the designation 'rainworm,' but to speak of a Turbellarian as a 'coiled-worm' can not be said to have the authorization of usage; 'tinting and dissection' mean staining and sectioning in ordinary parlance; and it is rather amusing to find one of His's reconstructions described as 'invented' by him. The rabbit is throughout transformed into a hare; *Echidna* is labeled a 'sea-urchin,' and a plate showing variations in the form of the pinna of the ear has for its legend 'ear muscles' (cf. Ohrmuscheln). On the whole, however, the translation is readable and set forth in idiomatic English.

J. P. McM.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Comparative Neurology and Psychology for July contains two leading articles: (1) 'The Sense of Hearing in Frogs,' by Robert M. Yerkes. Although in nature frogs seem very insensitive to sounds, yet both field observations and laboratory experiments show that their hearing is good over a wide range of sounds. The sense of hearing apparently serves rather as a warning sense which modifies reactions to other simultaneous or succeeding stimuli, than as a control for definite auditory motor reactions. Sounds which never cause a motor reaction are found to reinforce an accompanying visual or tactile reaction and under other conditions to inhibit reaction. (2) 'The Reactions of Ranatra to Light,' by S. J. Holmes. A detailed laboratory study of the phototactic reactions of the common water scorpion, with a discussion of the general theories suggested by them.

The July number of the *Journal of Nervous and Mental Diseases* opens with the presidential address delivered at the meeting of the American Neurological Association, June 1, 1905, by Dr. William G. Spiller. Dr. Spiller follows a custom more prevalent abroad than at home on such occasions and discusses a subject of general interest, namely, disturbances in the associated movements of the eyes as affording a sign of localizing value in lesions of the brain. He makes an exhaustive summary of the literature and adds reports of a number of cases of his own, with numerous illustrations. The paper is to be continued in the next number. The second article is by Dr. Smith Ely Jeliffe, of New York, on 'Dispensary Work in Nervous Diseases,' being a report of the clinic of Professor M. Allen Starr for the year 1904. This is followed by a paper by Dr. Robert H. Chase, of Philadelphia, on 'Delusions of the Insane.'

The contents of the *Journal of Infectious Diseases* is as follows:

Tileston, Wilder, and Locke, Edwin A.: 'The Blood in Scarlet Fever.'

Wherry, Wm. B., and McDill, John R.: 'Notes on a Base of *Hematochyluria*, Together with Some Observations on the Morphology of the Embryo Nematode—*Filaria Nocturna*.'

Butterfield, Elmore E.: 'Case of Pulmonary Infection with an Acid-fast Actinomycosis.'

Edwards, Ralph T.: '*Bacillus Mycogenes* (*Bacterium Mucogenum*) Nov. Spec., an Organism Belonging to the *Bacillus Mucosus Capsulatus* Group.'

Wherry, Wm. B.: 'A Search into the Nitrate and Nitrite Content of Witte's "Peptone" with Special Reference to its Influence on the Demonstration of the Indol and Cholera Red Reactions.'

Weaver, George H., and Tunniclift, Ruth: 'The Occurrence of Fusiform Bacilli and Spirilla in Connection with Morbid Processes.'

Manwarring, W. H.: 'A Quantitative Study of Hemolytic Serum.'

Manwarring, W. H.: 'The Absorption of Hemolytic Ambocœptor.'

Robinson, G. C.: 'The Rôle of the Typhoid Bacillus in the Pulmonary Complications of Typhoid Fever.'

Jordan, E. O.: 'Thermostalbe, Hemolytic Precipitate from Nutrient Broth.'

Gwyn, N. B. and Harris, N. MacL.: 'A Comparison between the Results of Blood Cultures Taken During Life and After Death.'

Guthrie, C. C.: 'A Contribution to the Clinical Knowledge of Texas Fever.'

DISCUSSION AND CORRESPONDENCE.

ANCIENT GREEK FISH AND OTHER NAMES.

In Science for July 7 (p. 23) Dr. C. R. Eastman has given some valuable references to authors treating of the ancient Greek names of fishes but has omitted notice of the most important and trustworthy of all. Besides other data, Cuvier and Valenciennes, in their 'Histoire Naturelle des Poissons' (1828–1849), have embodied quite full notices of the ancient literature concerning the species they treat of. Their greatly superior knowledge of the fauna of the Greek peninsula and archipelago enabled them to make better identifications than any of their predecessors. It is from the neglect of that great work, and not of Artedi's, that Hoffman and Jordan have failed to make their contribution as valuable as it might have been. Had they used the work they would not have fallen into the error of confusing the accounts of the *σκάρσο* and *σπάρος* as they have done—and as Apostolides also has done! In most respects Hoffman and Jordan's work is excellent.

I can by no means assent to the estimate as to 'the extremely valuable historical and bibliographical works of Artedi.' Indeed, there are few errors more deplorable than Artedi's misidentifications which have entailed on ichthyological nomenclature such monstrosities as the use of *Esox* (corrupted from a Gallic or Teutonic name of the sturgeon) for the pike, of *Echeneis* (a blenny) for the sea suckers, of *Exocœtus* (a goby or blenny) for the flying fishes, of *Trigla* (a surmullet) for the gurnards, and of *Callionymus* (a stargazer) for the dragonets. The example thus set was followed by Linné and others, so that most of the Greek names now in use for fish genera have a signification neither justified by ancient usage nor by analogy.

A new English translation of Aristotle's zoological works is a great desideratum. The old translations are poor and inferior to

Barthélemy-Saint Hilaire's French translations. In my youth I had hoped and expected to translate the 'History of Animals,' and even commenced it; other matters, however, distracted me, and I endeavored to interest others, but without eventual success. Some years ago Professor D'Arcy W. Thompson, of Dundee, informed me that he had almost completed a translation, but it has not yet been put to press. A good translation would demand a union of such qualifications as Professor Thompson has, and most of his predecessors did not have—an intimate acquaintance with the Greek language as well as of the Greek animals. The union of President Jordan with Professor Hoffman realized the demand so far as the fishes were involved.

The difficulty encountered by the would-be translator of Aristotle was entertainingly illustrated in 1862. The Rev. W. Houghton, in an article in the *Natural History Review* (II., 136–149), "On the Desirability of an English Translation of Aristotle's 'History of Animals,'" gave a translation of the first chapter of the first book of the history, which was soon criticized (II., 329–332) by Dr. John Scouler and, after a couple of admissions, defended (II., 408–415) by the translator. Meanwhile, in the same year, appeared Richard Creswell's translation. A comparison of Houghton's and Creswell's translations with each other and the original will show how different such may be without either deviating excessively from the Greek text. On the whole, there is no urgent reason to regret that Houghton's translation was not completed instead of Creswell's. The absence of a sufficient knowledge of zoology is, however, sometimes glaringly manifest in Creswell's work, especially in the identifications of the Aristotelian names in footnotes and the index.

Scores of mistranslations or faulty translations occur in Creswell's work, and a couple illustrating the kinds may be cited. "Some animals unite in their nature the characteristics of man and quadrupeds, as apes, monkeys and cynocephali"! (p. 32). This does not represent what Aristotle intended; he meant that some animals combine in their persons characteristics of man and quadrupeds, and instanced as such macaques (πιθήκοι), monkeys (κῆβοι) and baboons (κυνοκέφαλοι). The word ape nowadays is mostly limited to the tailless anthropoid apes which were entirely unknown to Aristotle and the Greeks.

Apropos of tails and hair, Aristotle promises to speak of the monkey-like animals subsequently, but notices the hippelaphus or nilgau and indicates that it has a beard under the throat. Creswell says (p. 26): 'the hipellaphus has a beard upon its larynx'! The erroneous spelling hipellaphus is repeated on the same page.

A word as to the use of Aristotle. His zoological treatises are not repertories of exact information to which a learner should be referred, though proclaimed to be such by some. In my youthful days I was advised by an eminent naturalist of the time to study and follow Aristotle. It happened that I had studied and in a special article 'On the Status of Aristotle in Systematic Zoology' (*Am. Nat.* for 1873) I gave reasons why I considered it inexpedient to follow him. Let me add another now. As Dr. Eastman well knows, several paleichthyologists have recently been basing new names on fossil otoliths or earbones of fishes. He and others may be amused by Aristotle's ideas respecting the otoliths of some Greek fishes. "Those which have a stone in their head, as the chromis, labrax, sciæna and phagrus, suffer most in the winter; for the refrigeration of the stone causes them to freeze and be driven on shore" (VIII., xx, 5)!

THEO. GILL.

ENGINEERING PROBLEMS IN A COURSE IN PHYSICS.

TO THE EDITOR OF SCIENCE: Last fall my attention was attracted to a letter published in SCIENCE from a professor of physics in a school of engineering. He asked if others agreed with him that more of 'pure science' ought to be required in engineering courses. At least some of us who are not teaching in either technical or engineering schools feel a need that is just the opposite to the one above expressed. It would be of much assist-

ance to those of us who are not engineers, and, because of preferences in other directions, do not wish to become engineers, to have a laboratory manual which, along with courses in measurement, contains directions for work which is on clearly and definitely stated engineering problems. From our standpoint what we need is to get our teaching in part out of the confines of the class-room and even of the laboratory and bring it more into touch with the commercial application of the work. The following outline, arranged to supplement my laboratory course in heat, may serve to indicate what it seems to me is wanted in each branch of physics. If there is a laboratory guide published which includes such plans, I should like to know of it.

SUPPLEMENTARY WORK IN PHYSICS. II. HEAT.

1. Coal.

Plan an experiment to determine the amount of heat generated in the combustion of a pound of coal, and write out a report in full in the usual form, leaving blank spaces for the insertion of the data when obtained. After consultation as to the plan you may determine how many pounds of water a pound of coal will raise one degree Fahr. when no heat is lost.

Average data for comparison: Heat from the combustion of one pound of anthracite coal will raise the temperature of 14,000 pounds of water 1° F. Heat from the combustion of one pound of coke will raise the temperature of 14,000 pounds of water 1° F. Heat from the combustion of one pound of crude oil will raise the temperature of 19,000 pounds of water 1° F. Heat from the combustion of one pound of gas will raise the temperature of 1,000 pounds of water 1° F. Heat from the combustion of one pound of hard wood will raise the temperature of 8,500 pounds of water 1° F. Heat from the combustion of one pound of soft pine will raise the temperature of 9,000 pounds of water 1° F. Heat from the combustion of one pound of peat will raise the temperature of 6,000–10,000 pounds of water 1° F. There are no data on the kind of coal which we have.

2. Boiler. (Study of boiler at the college heating plant.)

The engineer will tell how much the level of water in the boiler has been lowered in one day without return of water to the boiler, and how much coal was actually used.

How much would have been needed to evaporate this water under the pressure of forty pounds per square inch if no heat were lost? What is the efficiency of the boiler? What horse power was actually generated?

About ten square feet of heating surface are needed per horse power. What is the rating of the boiler?

The ratio of water heating area to the area of the grate is generally 20–25 to 1. What is the ratio in these boilers?

What is the pressure of steam in one of the boilers? Determine with a thermometer the temperature of the water in the boiler. How does this temperature compare with the temperature given in the curve of steam pressure?

3. The System on Heating.

Follow the steam pipes to the tunnels, determine the use of each pipe and see what the different valves control. Is any part of the system not under complete control? How is air removed from the pipes? In what different ways may water be obtained and forced into the boilers?

What is the temperature of steam in the mains? What is the temperature of the water in the return pipes? How much heat was radiated from the radiators and pipes? (For quantity of steam, see data obtained on boilers.)

Make the necessary measurements in the room assigned you to determine the number of cubic feet of space, the area of the radiating surface, etc., and ascertain whether there is sufficient radiating surface for the room. The following is one of the tables used in such estimates: For each 200 cu. ft. of space allow 1 sq. ft. of radiating surface. For each 20 sq. ft. of exposed wall allow 1 sq. ft. of radiating surface. For each 2 sq. ft. of glass allow 1 sq. ft. of radiating surface. If the building is poorly constructed twenty per cent. is added to the radiating surface. (To save a large part of the computing, see tables on page 6, Mechanics' Pocket Memorandum.)

If a hot water heating system were used five thirds as much radiating surface would be required. What is the exact ratio between the heat given out in the pipes by a quantity of steam at one and one half pounds pressure and the same quantity of water at 150° F., both cooling down to the temperature of the water in the return pipes? What bearing does the curve of cooling which you have drawn have on the selection of a ratio for estimates?

4. Engine (at electric light plant).

Explain how the valves control the steam ad-

mitted to the cylinder. At what pressure is the steam when admitted to the cylinder? What is the temperature of the steam for this pressure? (See curve of steam pressure.) Does the maximum pressure recorded on the indicator card correspond to that registered by the steam gauge? During what fraction of a stroke is the maximum pressure upon the piston exerted? (See indicator card.)

Ascertain the internal dimensions of the cylinder. What is the temperature and what the pressure of the exhaust steam?

How many units of heat disappear as the quantity of steam which enters the cylinder at one time expands to the temperature and pressure at the close of the stroke? (For final pressure see indicator diagram.) How many units of heat disappear as the quantity of steam which enters the cylinder at one time expands to the temperature and pressure of the exhaust steam? (In what other ways has heat disappeared?) What efficiency do these figures indicate?

Count the number of strokes per minute, and determine the average pressure of steam in the cylinder. (See indicator diagram.) What horsepower is the engine developing?

If the exhaust steam were conducted to another cylinder attached to the same shaft and all the heat which escapes to the exhaust were utilized in this second cylinder, how many times larger should the area of the piston be than that of the first, the length of stroke in the two engines being the same?

Assuming the boiler at this plant to have the same efficiency as that of the boilers at the college heating plant, and omitting further loss by radiation from the steam pipes, what part of the energy developed in the burning of a pound of coal actually appears as work?

JOHN L. TILTON.

SIMPSON COLLEGE,
INDIANOLA, IOWA.

ARGUMENTS ALLEGED AGAINST THE DOCTRINE OF ORGANIC EVOLUTION.

TO THE EDITOR OF SCIENCE: It is not often that in a single article emanating from good authority, one is able to find, in concise form, many of the so-called arguments of the anti-evolutionist against the theory of the animal descent of man. One of the most typical and most recent of these expositions upon the relation of belief in this theory, with Biblical teachings and established scientific facts, together with what purports to be a registration of vital points which would make a belief in the evolution theory incredible, has come from Professor L. T. Townsend, of Drew Theological Seminary, in an address entitled, 'The Collapse of Evolution,' delivered recently before the American Bible League, at the Boston convention.

This exposition appears to give in brief form, an excellent idea of the attitude of the average anti-evolutionist in respect to some of the fundamental principles of the descent theory (especially from the theological standpoint). Believing that there may be some of your readers who would appreciate a concise statement of this attitude, and of the arguments which so many of the more conservative anti-evolutionists of theological profession hold towards certain phases of this much troubled question, I have ventured to enclose to you in brief, argumentative form (although the address does not readily lend itself to such arrangement) an account of this article which, so far as I am aware, has appeared only in a periodical of limited circulation, *The Bible Student and Teacher;* and which, to my mind, shows the theological anti-evolutionist's standpoint in a definite and concise manner.

I undertake at this time no criticism of any part of Professor Townsend's argument, but attempt merely to state the argumentative points of the address in the clearest and most logical sequence possible. That many points require criticism will be apparent to the most casual reader; that, however, I leave to others. The following is the gist of the argument:

ASSERTION.

The theory of evolution and the animal descent of man is a poorly constructed affair, supported by not one single well-established fact in science, philosophy or religion, for:

I. The assertion that the original germs of animal life do not require the supernatural is false, for:
   1. Natural forces to-day can not produce the same germs.
   2. Spontaneous generation, in any sense, is not proved possible at the present day, 'and is no longer mentioned in scientific circles.'

3. Many famous biologists have abandoned the theories of the natural origin of life, for:
   A. Huxley was led reluctantly to give up his bioplastic theory.
   B. Sir William Thomson surrendered his speculation that life germs came to this earth from some planet.
   C. Herbert Spencer abandoned his theory of the 'chemical origin of life.'
   D. Tyndall said: 'Proofs that spontaneous generation has occurred at any time in the earth's history, are still wanting.'
   E. Virchow held that there was no evidence that the original germs arose by spontaneous generation.

II. There is no truth in the law of universal development and improvement of animals, for:
1. From the 'primordeal zone' to the present, the multitude of species have shown no improvement since their creation, for:
   A. The marine algæ found to-day are no more perfect than those found in the distant Silurian period.
   B. Among trees, the oak, birch, hazel, Scotch fir, have shown no improvement in thousands of years.
   C. The coral 'insects' which built the first coral reefs in Florida, have shown no improvement in 300 centuries.
   D. The crustacean family, since its appearance at the close of the carboniferous period, has not changed.
   E. The molluscs, fishes, reptiles, birds and mammals have never shown the least improvement or elaboration since their appearance.
   F. Mummies of cats, bulls, ibices, birds, dogs and crocodiles from the tombs of Egypt, have shown no change in 5,000 years; are identical with their living representatives of to-day.
   G. The 'Cro-Magnon' skull belonging to the earliest stone age, is not different from the human skulls of to-day.
   H. A scientist, having examined the statuettes recently discovered in Crete, concludes that the muscles and veins of the forearm of man have not changed in 4,000 years.
2. On the other hand, in scores of instances there is a pronounced deterioration of both parts and functions, for:
   A. One may observe cases of degeneration in:
      a. The acidians.
      b. Many parasitic species.
      c. The fishes (constant degeneration since the Devonian period).
      d. All the lower mammals.
      e. The whole human race.

III. There is no such thing as transmutation of species by natural processes, for:
1. The proofs which evolutionists have brought forward in favor of transmutation are in reality, meaningless, for:
   A. Geological records do not uphold the theory, for:
      a. In such cases as the supposed phylogeny of the horse, the resemblances between the original four-toed animals and the modern horse, 'are no greater than those between a cow and a crow, or between a man and a mouse; and this is no evidence of transmutation.'
      b. The so-called missing link, pithecanthropus erectus, is no evidence, for:
         a'. At the meeting of famous zoologists at Leyden, only seven out of twenty-four agreed that the 'pithecanthropus' was a missing link.
         b'. Professor D. C. Cunningham, of Dublin, concluded that this lot of bones was part baboon and part human.
   B. Biological records do not uphold the theory of transmutation, for:
      a. Manifestations of the principle of the biogenetic law furnish no support for the theory, for:
         a'. This law but shows the 'prophetic element in nature'; *i. e.*, the creator is a prophet and his method is to anticipate by type, pattern or prophecy, what may be expected in his subsequent creations.
      b. The ease with which present-day scientists can place in its proper class and order any fossil or prehistoric animal, is a sign that species have not changed.
      c. No one has ever been able to change the structureless germ of one plant or animal into the structureless germ of another.
      d. Sterility of the offspring of crossed species bars the most available way for the process of transmutation to act.

IV. There is no emergence of man from the brute condition, for:
1. Geology, history, archeology, anatomy, philology, ethics and religion demonstrate the fact that the first beings on earth which

wore the human form were not brutes nor even barbarians, but were as perfect in brain and as capable in intellect as any people now living, for:

A. Geology, archeology and anthropology all concur in the facts that:

a. The human race was not existent before the close of the glacial period; *i. e.*, about 15,000 years ago.

b. Man was highly civilized 7,000 years ago, and has not materially changed since that time.

c. There is left only 8,000 years for the rise of man from the brute condition—a fact which is incredible when we note that man has not changed at all in the last 7,000 years.

B. Philological research demonstrates the fact that the languages of all primitive tribes have undergone a descent rather than an ascent.

C. A study of comparative religion shows that all forms of worship emanated from a true worship of one supreme being.

D. The ethical codes of the ancient Babylonians and Egyptians excelled in loftiness and purity ours of the present day, which have degenerated.

V. The scholars and scientists are not all evolutionists, for:

1. Dr. N. S. Shaler, of Harvard University, says: 'It begins to be evident to naturalists that the Darwinian hypothesis is still unverified. Notwithstanding the evidence derived from animals and plants under domestication, it has not been proved that a single species * * * has been established by the operation of natural selection."[1]
2. St. George Mivart, of the University College, Kensington, says of the theory: 'I can not call it anything but a puerile hypothesis.'
3. Dr. Etheridge, of the British Museum, remarks: 'Nine tenths of the talk of evolutionists is sheer nonsense; it is not founded by observation, and wholly unsupported by fact.'
4. L. S. Beale, of King's College, London, says: 'There is no evidence that a man has descended from, or is or was in any way specially related to, any other organism, in nature, through evolution or any other process.'
5. M. Stanislas Meunier, of the Paris Museum, argues in favor of special creation by an infinite power.
6. Virchow, speaking of evolution, said: 'It is all nonsense. It can not be proved by science that man descends from the ape or from any other animal.'
7. Fleishmann, of Erlangen, said: 'The Darwinian theory of descent has not a single fact to confirm it. It is a product of the imagination.'
8. Edward von Hartmann in his work, 'The Passing of Darwinism,' shows that the theory is now incredible.
9. Dr. A. H. Sayes, of Oxford, says: 'The application of the evolution theory to the religious and secular history of the world, is founded on a huge mistake.'
10. Many others, as Donnert, Goette, Hoppe, Paulsen, Rutermeyer, Wundt, Zoeckler and Griefswald, once supporters of evolution, have now abandoned it.

[1] This is a misinterpretation of Dr. Shaler's attitude which is decidedly in favor of some evolution hypothesis.—P. B. H.

CONCLUSION.

In view of the facts:

1. That the advocates of evolution can not prove that life germs arose by natural processes;
2. That evolutionists show an utter inability to prove that there exists a universal law of development and improvement;
3. That they can not prove lower species of plants can be transmuted into higher;
4. That in all excavations not a single connecting link between species has been discovered;
5. That physical and mental science proves it to be impossible for an animal to come into possession of a human soul, human mind or human body;
6. That geologists have silenced the voices of the advocates of the animal descent of man;
7. That all scholarly men and scientists are not evolutionists;
8. That many who once upheld evolution are now abandoning it;

There need not be a moment's hesitation in saying that the hypothesis of evolution, with all the other speculations attached to it, has collapsed beyond the hope of restoration.

PHIL. B. HADLEY.

ANATOMICAL LABORATORY,
BROWN UNIVERSITY,
March 4, 1905.

SPECIAL ARTICLES.

EFFECT OF THE CONCENTRATION OF THE NUTRIENT SOLUTION UPON WHEAT CULTURES.

THE work here reported was undertaken to determine the concentration of a nutrient solution which is best adapted to the growth of wheat, and further to find out whether or not an increase in concentration alone may accelerate growth aside from changes in the nutrient value of the solution. The nutrient solution used contained calcium sulphate, magnesium phosphate, potassium carbonate, sodium nitrate and ammonium chloride in chemically equivalent amounts. It was made up to concentrations of 10, 70, 150, 745 and 1,545 parts per million, respectively. To each solution 5 parts per million of ferric chloride were added, thus making the concentrations of total salts 15, 75, 155, 750 and 1,550 parts per million. In the two higher concentrations some phosphates and carbonates of calcium and magnesium were precipitated out, but the error thus produced is too small to affect the general results under consideration.

A series of cultures of wheat seedlings was grown for 28 days in these solutions, the latter being changed every day. At the end of the period the plants in the solution of 15 parts per million were the poorest of the lot, being remarkably stunted, as though suffering for want of water. Those in the solution of 75 parts per million were considerably better, while those in the solution of 155 parts per million were unmistakably the best. Those in the solution of 750 parts per million were similar to those in the one of 75 parts, while those in the solution of 1,550 parts per million were again very poor and showed the same stunting of growth as do plants growing in alkali soils.

This experiment was performed six times with different growing conditions, and each time the results were in the same order. The general development was always in the same relative order as the transpiration.[1]

[1] For evidence in regard to the use of transpiration as a criterion here, see a paper about to appear in the *Botanical Gazette*, Livingston, B. E., 'Relation of Transpiration to Growth in Wheat.'

In Table I. are given the number of plants used in each experiment and the relative transpirations for the different cultures of the six experiments, all calculated to a uniform basis of 15 days each. In calculating the relative transpirations, the total transpiration of the culture in the weakest solution is considered as 100.

TABLE I.

Data for Experiments I. to VI.

Exp. No.	No. of Plants.	Relative Transpirations for Period of 15 days in Nutrient Solutions of the Following Concentrations:				
		15 p. p. m.	75 p. p. m.	155 p. p. m.	750 p. p. m.	1,550 p. p. m.
I.	24	100	209.3	330.2	197.6	253.5
II.	36	100	132.6	154.4	134.3	107.3
III.	36	100	134.9	181.3	158 9	81.4
IV.	24	100	151.6	151.6	138.3	120.0
V.	24	100	186.1	157.0	193.0	125 5
VI.	60	100	155 5	157.9	157.9	104.1
Av. for 204 plants.		100	161.6	188.7	163.3	131.9

It will be seen from the table that curves of these transpirations would have maximum points somewhere between 155 and 750 parts per million of total solids in solution. No attempt was made to determine the maximum point more accurately, but by interpolation it is estimated to lie in the vicinity of 300 parts per million of total solids. This may be taken as approximately the concentration best suited to growth under the conditions of these experiments.

Whether the depression noticed in the lower concentrations of the above series is due to a scarcity of one or more of the nutritive elements or to the low concentration of the solution as a whole is considered in the following experiments. In experiment VII. to each of four portions of the solution above described, containing 15 parts per million of total salts, were added 140 parts per million of one of the salts occurring in the original solution, a different salt being used in each case. To a fifth portion was added 140 parts per million of a mixture of all four of these salts in chemically equivalent amounts. Twenty-four plants were grown in each of the five solutions for thirteen days, and their growth was compared with that of a similar culture in the

original solution. Table II. presents the data for this experiment as well as for the two following ones. Relative transpirations on the basis of 100 for the original nutrient solution of 15 parts per million are given. There was a marked increase in the growth of the plants, with the addition of each one of the salts, but none of them produced as good plants as did the combination of all four salts.

In experiment VIII. the same solution of 15 parts per million was increased in concentration by the addition of 60, 140, 735 and 1,535 parts per million of calcium sulphate. Thirty-six seedlings were grown in each solution for thirteen days, comparison being again made with the original solution. The increase in transpiration was also very marked in this case, as is shown by the data in Table II. Here the transpiration figures tend to show a depressing effect in the solution of highest concentration, as in the former case. This experiment was repeated with similar results.

TABLE II.

Data for Experiments VII. to IX.

	Medium.	Relative Transpirations for Period of Experiment.
Experiment VII., 24 plants, 13 days.	Nutrient solution, 15 p. p. m.	100.0
	Do. + 140 p. p. m. $CaSO_4$.	205.5
	Do. + 140 p. p. m. $MgHPO_4$.	143.5
	Do. + 140 p. p. m. K_2CO_3.	224.4
	Do. + 140 p. p. m. $NaNO_3$.	156.2
	Do. + 140 p. p. m. of four above salts, in chem. equiv. amounts.	241.9
Experiment VIII., 36 plants, 13 days.	Nutrient solution, 15 p. p. m.	100.0
	Do. + 60 p. p. m. $CaSO_4$.	117.8
	Do. + 140 p. p. m. $CaSO_4$.	157.7
	Do. + 735 p. p. m. $CaSO_4$.	188 9
	Do. + 1535 p. p. m $CaSO_4$.	155.5
Experiment IX., 60 plants, 15 days.	Nutrient solution, 15 p. p. m.	100.0
	Do. + 60 p. p. m. NaCl.	111.1
	Do. + 140 p. p. m. NaCl.	114.9
	Do. + 735 p. p. m. NaCl.	117.2
	Do. + 1535 p. p. m. NaCl.	95.4

Sodium chloride, which furnishes none of the elements usually classified as plant food materials, was also used to increase the concentration of the original solution. Sixty plants were used in this case, being grown for fifteen days. The treatment was the same as that with calcium sulphate just described, and the results showed the same general effect, although the actual differences between the different cultures were not nearly as great. The last fact is probably due to the toxic effect of the chlorine ion, tending to retard growth and thus partially masking the effect of concentration. The data are given in Table II.

From the experiments thus far described it is evident that there is an optimum physical concentration of the nutrient solution at which water cultures of wheat thrive best, aside from variations in the amounts present of the different nutrient materials. In the solutions of lower concentration the retarding factor for plant growth is not necessarily connected with the low osmotic pressure, for the same acceleration of growth which is observed to accompany an increase in concentration can be obtained by entirely different means. The author has already called attention to the fact that both nutrient solutions and soil extracts are greatly improved for the growth of wheat by addition of small quantities of the practically insoluble bodies, carbon black and ferric hydrate[2] and that the beneficial effect of these bodies is due to their power to absorb toxic substances. Such toxic materials are present in many soils, and physiologically similar ones are given off by the roots of wheat grown in water culture.[3] The addition of these insoluble bodies to a weak nutrient solution can not possibly increase its concentration to any appreciable degree; indeed, such addition is apt to decrease its concentration to some extent owing to phenomena of adsorption. Yet such treatments result in the same sort of acceleration of growth as is obtained with increase in concentration.

Dr. B. E. Livingston, of the bureau of soils, has made possible a quantitative comparison in this regard by furnishing the author with

[2] Breazeale, J. F., 'Effect of Certain Solids upon the Growth of Wheat in Water Cultures,' about to appear in the *Botanical Gazette*.

[3] In this regard see Livingston, B. E., Britton, J. C., and Reid, F. R., 'Studies on the Properties of a Sterile Soil, U. S. Dept. Agric., Bureau of Soils, Bul. No. 28.

unpublished data from experiments which he has recently performed. He finds from an average of six different tests in which ferric hydrate was added to the nutrient solution described above, the latter having a concentration of 75 parts per million, that growth is accelerated by this treatment to an extent equivalent to 26.2 per cent., the growth obtained in the untreated solution being considered as unity for the comparison. The same nutrient solution with carbon black gave 35 per cent. increase in growth on the same basis. The last figure is an average of the results of two experiments.

TABLE III.

Data for Experiment XI.

Solution Used on Sand.	Transpiration for 2 Days.	
	In Grs.	Relative.
Nutrient solution, 15 p. p. m.	44	100
Do. 75 p. p. m.	45	102.3
Do. 155 p. p. m.	65	147.7
Do. 750 p. p. m.	127	288.7
Do. 1,550 p. p. m.	150	340 9
Do. 75 p. p. m. + 305 p. p. m. NaCl.	56	127.3
Do. 75 p p. m. + 305 p. p. m. $CaCl_2$.	60	136.4

TABLE IV.

Data for Experiment XII.

Solution Used on Sand.	Transpiration for 2 Days.	
	In Grs.	Relative.
Nutrient solution, 75 p. p. m.	24	100
Do. 750 p. p. m.	50	208.3
Do. 75 p. p. m. + 675 p. p. m. NaCl.	32	133.3
Do. 75 p. p. m. + 675 p. p. m. $CaSO_4$.	31	129.2
Do. 75 p. p. m. + 675 p. p. m. Na_2HPO_4.	35	145.8

The data of experiments I. to VI. of the present paper (Table I.) show that the average growth in the nutrient solution of 75 parts per million is 161.6, and for the same solution of a concentration of 155 parts per million the average growth is 188.7. On the average, the latter concentration is the optimum for wheat growth as nearly as this can be approximated from the series, so that the acceleration which it is possible to obtain by increase in concentration is 188.7 — 161.6/161.6, or 16.8 per cent. Considering only the four experiments which showed an increase in favor of the stronger of these two concentrations (experiments I., II., III. and VI.), this average is, of course, much higher, being 27 per cent., or very nearly the same as the increase obtained by treating the weaker solution with ferric hydrate, and considerably less than that obtained with carbon. Thus we are confronted with a case where two entirely different treatments bring about the same effect upon the plant. It is practically proved that the insoluble bodies have their effect here by removing from solution the deleterious excretions of the plant roots. The effect of increase in concentration may be explained by one or more of the three following hypotheses: The higher concentration may make the plant more resistant to the poisons; it may actually prevent the excretion of such poisons from the roots; or with higher concentration of salts the poisons themselves may be altered so as to lose their toxic properties. Which of these explanations is correct can not be decided now, but it is at any rate very clear that the acceleration observed has no direct connection with the nutrient value of the medium.

In soil or sand cultures the effect of concentration is known to be very different from that in water cultures; for instance, the concentration best suited to wheat in water culture is about 300 parts per million of nutrient solution, while in sand it lies in the vicinity of 2,500 parts per million. To investigate the question whether the effect of strength of solution in sand is due to physical concentration or to chemical conditions of nutriment, several series of sand cultures were carried out.

Pure quartz sand was placed in paraffined wire baskets of the form described in Bulletin No. 23 of this bureau, and the hardened paraffin at the bottom was punctured with pin holes to allow free drainage. In experiment X. six wheat plants were grown in these baskets for sixteen days, the sand being flooded daily with nutrient solutions of concentrations of 15, 75, 750 and 1,550 parts per million of total salts, respectively, while the excess of solution was allowed to drain out

through the bottom. In this way the plants were kept abundantly supplied with fresh solution. At the end of this period the differences in growth were very marked, there being a gradual increase in growth from those flooded with the weakest to those flooded with the strongest solution, the latter culture being by far the best of the series. This experiment was repeated as experiment XI., and in addition the solution of 75 parts per million was increased in concentration by the addition of 305 parts per million of sodium chloride and also of an equal amount of calcium chloride. The baskets were flooded with the solution daily for 18 days, at the end of which time they were sealed over the top with paper and paraffin to prevent evaporation from the surface of the sand, a small opening being left for the stems. The transpirations were then taken for two days and are given in Table III., together with the relative figures obtained by considering the transpiration of the first culture as 100. The figures are relatively proportional to the size of the plants at this time.

Here the same gradation of growth is apparent in the series of different concentrations of nutrient solution as was observed in experiment XI. Furthermore, addition of either sodium chloride or calcium chloride produces a marked increase in growth. This test was repeated as experiment XII., this time taking as controls the nutrient solution in concentrations of 75 and 750 parts per million and increasing the concentration of separate portions of the weaker of these by addition of 675 parts per million of sodium chloride, of calcium sulphate and of sodium phosphate, respectively. The cultures were treated in the same manner as in experiment XI. until the twenty-seventh day, after which they were sealed and weighed. The transpiration for two days is given in Table IV., together with relative figures obtained in the usual manner.

From the last three experiments it appears that in quartz sand as well as in a free solution the concentration of dissolved salts is a factor in determining plant growth, independently of any changes in the nutrient value of the medium. This may be so in ordinary soils, as well, although of course the problem here is complicated by the presence of undissolved nutrient materials in the soil. Ferric hydrate and carbon black have the same beneficial effect when mixed into many infertile soils as has been described for nutrient solutions, so that it appears that the above-mentioned hypotheses regarding toxic materials may be applied here also.

For many years experiment station workers have been studying the problem of the replacement of potassium by sodium compounds in commercial fertilizers. Marked increases in crop yields have been obtained by the addition of sodium chloride to soils receiving only a small amount of potassium. From the experiments here described it appears that this increase in yield may not at all be directly connected with any change in the nutritive content of the soil.

J. F. BREAZEALE.

BUREAU OF SOILS,
U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

THE CLASSIFICATION OF THE ORDOVICIAN ROCKS OF OHIO AND INDIANA.

A MORE detailed study of the great mass of strata included in the Cincinnatian series of the Ordovician rocks of Ohio, Indiana and Kentucky makes necessary the classification of these strata into divisions and subdivisions of the series. This service was rendered by Mr. John M. Nickles in his papers on the Geology of Cincinnati[1] and on the Richmond group in Ohio and Indiana.[2]

In the twenty-eighth annual report of the Indiana Geological Survey, published in 1903, the classification proposed by Nickles was adopted without change. Since the publication of this report, however, several changes in the nomenclature have seemed advisable. Some of these are due to the practise, which recently has become more general, of adopting distinct names for formations which formerly were considered approximately identical, whenever a study of their fossil faunas indicates that these formations were deposited in zoolog-

[1] *Journal Cincinnati Soc. Nat. Hist.*, 1902.
[2] *Am. Geol.*, 1903.

ical provinces essentially distinct. Now, a study of the fossil lists given by Nickles in his 'Geology of Cincinnati' indicates that the rocks at Cincinnati identified as Lorraine and Utica contain faunas so different from the typical Lorraine and Utica faunas of New York as to warrant the application of the principle above stated. For this reason the name *Maysville* is here suggested for the strata at Cincinnati hitherto identified as Lorraine. Along the railroad south of Maysville, Kentucky, from the first cut a little over a mile from town to the overhead bridge a mile north of Summit a magnificent series of exposures gives a complete section of all the subdivisions of the Maysville division, from the Mount Hope bed to the top of the bed formerly known as Warren. The name *Eden,* well defined by Orton in the first volume of the 'Geology of Ohio,' published in 1873, is revived for the strata which in the 'Geology of Cincinnati' are identified as Utica. Whether the clay bed, four or five feet thick, containing *Triarthrus becki,* at the base of the Eden division should be included in the Eden or not, is a question which requires further study. On the supposition that *Triarthrus becki* proves this clay layer to be of the same age as the Utica of New York, and that the Eden beds represent a later stage of deposition than the Utica of New York, the clay bed containing *Triarthrus becki* should be excluded from the Eden division. The writer, however, is not prepared to assert that the clay bed in question is the only representative at Cincinnati of the considerable thickness of black shales struck in the gas and oil wells of northern Ohio, and there identified as Utica. Nevertheless, it may be convenient to have a name for the *Triarthrus* horizon, and the name *Fulton layer* is here adopted, not because Fulton presents the best exposures, but because the names of the other localities at which this horizon occurs are already in use. Fulton was formerly a suburb of Cincinnati, and now forms part of the First Ward.[3] The other localities are in Taylors Creek, east of Newport; at the quarry along the railroad, about half a mile southeast of New Richmond, Ky.; and at Point Pleasant, O.

Several changes in nomenclature appear advisable on account of a second practise, which has become more imperative since the publication by Weeks, in 1902, of the 'North American Geologic Formation Names.' This practise opposes the use of the same name for different formations, even if widely separated geographically and belonging to widely different geological ages. In consequence the name *Saluda* was suggested in a paper on the Cincinnati geanticline in southern Kentucky[4] in place of Madison, and now the name *Arnheim* is proposed in place of Warren. This has the additional advantage of leading the investigator to a type locality where the characteristics of the formation can be well studied. Arnheim is a little village seven miles northeast of Georgetown in Brown County, O., and several miles east of the railroad from Georgetown to Sardinia, but is easily reached by good pikes. It makes up by the excellency of the exposures for its somewhat inconvenient location. The section begins a short distance south of town, at the Blue Banks, the first steep exposure along Straight Creek. Here the base of the Waynesville bed is twenty-five feet above the level of the creek, and the top of the Arnheim bed consists of the nodular clay layer so characteristic of the exposures of this bed in Warren County, O. The base of the Arnheim bed is a considerable distance down the stream, where it rests upon the top of the Mount Auburn bed, which contains an abundance of *Platystrophia lynx* at the top. The thickness of the Arnheim bed is estimated approximately at sixty-three feet.

In attempting to trace the Liberty and Whitewater beds in Indiana, the writer found great difficulty in separating these beds at any considerable distance from the type localities; for instance, at Madison, Indiana, and thence southward. For this reason it has seemed convenient to have a name for this part of the Richmond section, the Middle Richmond, when it is not found practicable readily to distinguish the smaller divisions. The name *Versailles bed* is here proposed. Along the

[3] 'Geology of Cincinnati,' p. 55.

[4] *Am. Geol.*, 1902.

road at the northern edge of Versailles, Ind., both the *Hebertella insculpta* horizon, at the base of the Versailles bed, and the *Columnaria* layer, immediately below the massive *Tetradium* layer, at the base of the Madison bed, are well exposed.[5]

The name *Garrard,* introduced by Campbell, in Folio No. 46, of the 'Geological Atlas of the United States,' 1898, may be used not only for the comparatively unfossiliferous Upper Eden beds of central Kentucky, but also for the equivalent, often richly fossiliferous, beds farther north.

Finally, the reference of the beds underlying the Eden opposite Warsaw, Ky., on the Indiana side of the Ohio River, to the Point Pleasant beds of Orton may be asserted with greater confidence, since these lower beds have been studied along the Ohio River as far east as Stony Point, a mile and a half east of Higginsport. At Point Pleasant, O., a short distance west of the town, the base of the clay layer with *Triarthrus becki* occurs 113 feet above the level of the river. From this level downward almost 50 feet of rock are quarried. Between the level of the river road and the river, a vertical distance of fifty-five feet, the exposures are very poor, and no quarrying operations are carried on here. It is very evident that Professor Orton referred to the quarried rocks, when proposing the name Point Pleasant beds. As late as 1893, in volume VII. of the 'Geological Survey of Ohio,' p. 4, he states distinctly that the Trenton limestone is seen only in the Point Pleasant quarries, if at all in the state. Professor Orton did not regard the quarried rocks at Point Pleasant as equivalent to the Lower or River quarry beds opposite Cincinnati, although both lie directly below the *Triarthrus becki* layer, and in this he has been followed by other investigators. The present writer, on the contrary, after an examination of all the exposures along the Ohio River, has come to the opposite conclusion. The observations which lead to this result are chiefly the following: The most characteristic and unbiquitous fossil in these beds all along the Ohio River is *Eridotrypa briareus.* Even if this fossil eventually should be found in the Lexington limestone, it can not be common there, since so far it has not been detected at all. In the next place, *Trinucleus concentricus* is found in the upper part of these beds at many localities. It is present opposite Warsaw; opposite Cincinnati it was detected as low as eighteen feet below the top of the heavy limestone beneath the Eden section. At Point Pleasant it occurs in the upper part of the section. Whatever its range may be elsewhere, along the Ohio River it does not extend below the upper part of the rocks here identified as Point Pleasant beds. It certainly never has been found in rocks known to be of Lexington age. Again, the rocks are very much alike lithologically. This usually does not appear where the rocks have been quarried, but where much weathered along the hillsides, the similarity of the rocks at Point Pleasant and at Cincinnati often is very striking. For instance, on the hillside southwest of the railroad trestle at Foster, Ky., near railroad level, the dense, fine-grained limestones with numerous cross-sections of gastropods, and the coarse-grained, more crinoidal limestones, often wave-marked along the top, have an appearance very much like the long-exposed rocks in the Mohawkian section opposite Cincinnati. These features are not presented by the Lexington rocks in central Kentucky.

The total thickness of rocks to be included in the Point Pleasant beds, if this name is to

Series.	Divisions.	Beds.
Cincinnatian.	Richmond.	Saluda.
		Versailles.
		Waynesville.
	Maysville.	Arnheim.
		Mount Auburn.
		Corryville.
		Bellevue.
		Fairmount.
		Mount Hope.
	Eden.	Garrard.
		Middle Eden.
		Lower Eden (Fulton layer).
Mohawkian.	(Upper Beds.)	Point Pleasant.
		Lexington (top only).

[5] *Am. Journ. of Sci.,* 1904, p. 329.

be retained, probably should be approximately one hundred feet. Below this level at Moscow, Carnestown, Foster and elsewhere, rocks appear which contain *Callopora multitabulata*, a characteristic Lexington fossil, identified by Bassler.

With the modifications suggested in the preceding lines, the Ordovician sections in Ohio and Indiana, and in the adjacent parts of Kentucky, may be classified as on p. 151.

Aug. F. Foerste.

Dayton, Ohio.

RECENT WORK OF THE WISCONSIN ARCHEOLOGICAL SOCIETY.

The recent work of the Wisconsin Archeological Society shows that it is steadily increasing in strength. It has succeeded in having passed by the state legislature bill No. 195 A, which was introduced early in February of this year and approved June 10.

The passage of this bill is notable, since it is the first archeological measure of the state government, being the only one to receive the unanimous support of the legislature. Many such bills have been introduced during the past twenty-five years, but most of them never left the committee in which they were introduced. Every member of the society has given this legislation his hearty support. The officers profited by the fate of the several archeological bills introduced in the legislature of their sister state, Michigan, and sought advice from those interested in archeological work in that state. Profiting from the plans for work in Michigan, they have not only developed the plans, but have actually put many of them in force. They have also adopted some entirely new methods of securing information and of popularizing and disseminating it.

The officers of the society are confident that the bill is only a beginning with the popular government. By this state aid their work will be facilitated, for under the provisions of the bill all the bulletins of the society will be printed by the state. Its results, being thus brought before the citizens, will no doubt prove the right of the society to further aid from the state in the near future.

The bill, which is an amendment to section 341, of the statutes of 1898, provides that "There shall be printed by the state printer bimonthly, in pamphlet form, 1,500 copies of the transactions of the Wisconsin Archeological Society, on good quality book paper, uniform in style with the volumes heretofore published by said society, including necessary illustrations, not to exceed 25 pages for each copy. . . . This act shall take effect and be in force from and after its passage and publication." One hundred and thirty-three free copies of each issue are to be presented to the Wisconsin Free Library Commission for distribution among its traveling libraries.

One of the first publications to be printed under the provisions of the state printing grant will be a monograph on 'The Aboriginal Pipes of Wisconsin,' by the president of the society, Mr. George A. West. Mr. West has devoted time and money for years in securing the material upon which this monograph is based.

The society also contemplates the publication of catalogues of all the archeological specimens found in Wisconsin, including especially those now kept in institutions outside the state, in order that students of the archeology of Wisconsin may know what material is available and where it is.

The standing committee on landmarks of the Wisconsin Federation of Women's Clubs is cooperating with the Wisconsin Archeological Society. Miss Julia A. Lapham, daughter of the late Dr. Lapham, one of the greatest authorities on the archeology of Wisconsin, is chairman of this committee, which has sent circulars to the Women's Clubs of the state. These circulars ask for a report on the work done by each club in response to a general order urging the study of local history and archeology and that local action be taken to preserve ancient landmarks, including Indian mounds, and also that a Landmarks Day be arranged in each year's program. Records are sought of Indian trails, old military and territorial roads, trading posts, first buildings and their purposes, portages, ferries, ancient village sites, mounds, ancient 'garden-beds'

and corn hills, traces of all of which are rapidly being destroyed. A plea is made that these at least be recorded and when possible photographed, marked and preserved. Every club is urged to investigate the meaning of the names of the cities, towns, counties and other places with any traditions regarding them.

Copies of all records prepared in response to these pleas, and all photographs, are requested to be sent in to the committee to be filed in the central office or bureau of records of the society.

The members of the society and its friends in Wisconsin having been relieved of the financial burden of the publication of the archeological bulletin, and having sufficiently supplemented the fund thus saved, are now able to provide funds to employ a manager for the work of the society throughout the state. This has made it possible for Mr. Charles E. Brown to resign from the staff of the Milwaukee Public Museum and to assume full direction of the central office of records and all field work in the state. He is at present systematizing and extending the work, much of his time being devoted to interesting local business men and to securing funds and memberships, as well as to the direction of exploration and the preservation of notes, photographs, maps and specimens.

Mr. Brown served the museum for seven years, and is specially fitted by his training and his careful disposition for the task of directing the work of the local society. He edited the four volumes of the bulletin which appeared before state aid was secured, is a founder of the American Anthropological Association and author of many papers on the archeology of Wisconsin.

The society has been incorporated under the laws of Wisconsin and numbers among its members hundreds of workers, some of them in each part of the state. It has already been able to preserve mounds at Waukesha, West Allis and other places and the archeological survey of the state has been completed in several counties. Public meetings are held and lectures are provided by the society which are intended especially for the public. For several years Beloit College has been offering courses in American archeology and history under the direction of Dr. George L. Collie.

The society is now establishing a central office and bureau of records. Its researches are being carried on in many parts of the state by more workers than were ever available before. The large number of these co-laborers is the result of the patient encouragement and guidance on the part of the society during the past years. Mr. Brown will himself be in the field in charge of an exploring party this season.

Several museums, libraries and colleges have been thus far selected as repositories for collections, but the plans of the society are that many more widely distributed places shall become such. An effort is being made to prevent the manufacture and traffic in counterfeit specimens, and to prevent collections or even specimens from leaving the state; but we believe that no sincere member of the society will do anything to prevent the great museums of our country and the world from securing representative educational collections or from carrying on research in the state. It is even our belief that the members will welcome cooperation in exploration, provided the work is properly done, the results are published and the specimens are kept available for students in a public institution. For synoptic collections to illustrate known facts, no doubt the society will eventually supply specimens from its duplicates.

Local collectors are being influenced to deposit their collections in their near-by educational institutions, but no effort is apparently being made to deprive any section of the state of collections in order to build up one great museum. This may cause students to spend some time in traveling from one museum to another, but it certainly stimulates local interest.

The Schumacher collection, consisting of a large series of objects from the Green Bay region, has been deposited by its owner, Mr. J. P. Schumacher, in the Kellogg Library at Green Bay, Wis.

The West collection of pipes, many of which are from Wisconsin, will be presented in time

to some Wisconsin institution. It comprises many hundreds of specimens representing every period and type from the primitive pebble and tubular forms to the pottery, lead and iron pipes of early historic times. It is unsurpassed by any private collection in its richness in monitor, disk, Micmac and Siouan pipes.

The James G. Pickett collection of Wisconsin implements has been purchased and presented to the Oshkosh Public Library through the interest of Mrs. Leander Choate. This collection consists of specimens collected in the Winnebago Lake region, which is remarkably rich in archeological material.

The collection of Wisconsin antiquities brought together by the late authority on Wisconsin archeology, Dr. I. A. Lapham, will soon find a home in the Milwaukee-Downer College, to which it will be presented by the Wisconsin Archeological Society to form there the nucleus of another repository for Wisconsin material.

The W. H. Elkey collection of nearly 6,000 selected Wisconsin implements made of stone and copper was purchased in June at the suggestion of the society by Mr. Frank A. Logan, of Chicago. Mr. Logan is a member of the society and secured the collection for the Logan Museum of Archeology at Beloit College, of Beloit, Wis. This is the second great Wisconsin collection which Mr. Logan has added to this museum during the past two years. Both Mr. Logan and Dr. George L. Collie, dean of the college and curator of the museum, are determined to make this museum the home of one of the greatest of the archeological collections to be made from the Great Lake region.

These are only a few of a large number of archeological collections from Wisconsin, all of them valuable, which the Wisconsin Archeological Society is determined to have secured for the state and students of its archeology. This may be done by deposit in local colleges, museums and institutions or by purchase and donation to such repositories. A large number of local institutions, in fact a majority of them, which have been strangely apathetic in the past, are now cooperating with the society in all these efforts.

In order to bring the work of the society before the general public and to interest them in the educational and historical value of the archeological material found in Wisconsin, the society will install at the September meeting of the state fair at State Fair Park, West Allis, an exhibit intended to illustrate by means of objects, photographs, maps, charts and models the chief archeological features of various sections of the state. For this purpose photographs are being taken or secured of mounds, specimens and others of the most popular and instructive antiquities of the state. Loans of specimens for the purpose are also being made to the society by its members in all parts of Wisconsin.

A group of mounds, the restoration and preservation of which were brought about by the society several years ago, is located on the fair grounds. The attention of visitors will be directed to this group, which will prove a wholesome object lesson to all who come from parts of the state where there are mounds capable of being so preserved. It will be remembered that such is the case in practically every part of the state.

Public lectures will be given at the fair by various prominent members of the society and literature will be distributed freely. In its undertakings in connection with the fair the society is receiving the assistance of the state board of agriculture.

The archeologists of Wisconsin began to take an active interest in the archeology of their state and to cooperate with each other only a few years ago. Previous to that time there were but few workers and no cooperation. They have worked patiently, perfecting an organization largely due to the efforts of Mr. Charles E. Brown, have sought advice freely and have adopted the best plans offered them. They have developed such plans and made original schemes of their own. They have never forgotten that their chief aim was research, while they have persistently popularized the work in a way that has built up a strong public opinion in their favor and a

goodly constituency. They are glad to teach what they have learned by research to any one who cares to learn. They are preserving archeological sites, specimens and records for future research and for educational purposes. Practically all this result has been secured in a period of less than five years.

HARLAN I. SMITH.
AMERICAN MUSEUM OF NATURAL HISTORY.

NATURE AND MAN.[1]

PROFESSOR LANKESTER in his Romanes lecture began by a statement of the theory of evolution, directing attention to unwarranted inferences commonly drawn by clever writers unacquainted with the study of nature. He described how the change in the character of the struggle for existence, possibly in the Lower Miocene period, which favored an increase in the size of the brain in the great mammals and the horse, probably became most important in the development of man. The progress of man cut him off from the general operation of the law of natural selection as it had worked until he appeared, and he acquired knowledge, reason, self-consciousness and will, so that 'survival of the fittest,' when applied to man, came to have a meaning quite different from what it had when applied to other creatures. Thus man can control nature, and the 'nature searchers,' the founders of the Royal Society and their followers, have placed boundless power in the hands of mankind, and enabled man to arrive at spiritual emancipation and freedom of thought. But the leaders of human activity at present still attach little or no importance to the study of nature. They ignore the penalties that rebellious man must pay if he fails to continue his study and acquire greater and greater control of nature.

Professor Lankester did not dwell upon the possible material loss to our empire which may result from neglect of natural science; he looks at the matter as a citizen of the world, as a man who sees that within some time, it may be only 100 years, it may be 500 years, man must solve many new problems if he is to continue his progress and avert a return to nature's terrible method of selecting the fittest. It seems to us that this aspect of the question has never been fully dealt with before. Throughout Huxley's later writings the certainty of a return to nature's method is always to be felt. Professor Lankester has faith in man's power to solve those problems.

The dangerous delay now so evident is due to the want of nature knowledge in the general population, so that the responsible administrators of government are suffered to remain ignorant of their duties. Professor Lankester shows that it is peculiarly in the power of such universities as Oxford and Cambridge, which are greatly free from government control, to establish a quite different state of things from that which now obtains in England. He says:

> The world has seen with admiration and astonishment the entire people of Japan follow the example of its governing class in the almost sudden adoption of the knowledge and control of nature as the purpose of national education and the guide of state administration. It is possible that in a less rapid and startling manner our old universities may, at no distant date, influence the intellectual life of the more fortunate of our fellow citizens, and consequently of the entire community.

Considering Oxford more particularly, and speaking for others as well as himself, he says:

> The University of Oxford by its present action in regard to the choice and direction of subjects of study is exercising an injurious influence upon the education of the country, and especially upon the education of those who will hereafter occupy positions of influence, and will largely determine both the action of the state and the education and opinions of those who will in turn succeed them.

As to Greek and Latin studies, he says:

> We have come to the conclusion that this form of education is a mistaken and injurious one. We desire to make the chief subject of education both in school and in college a knowledge of nature as set forth in the sciences which are spoken of as physics, chemistry, geology and biology. We think that all education should consist in the first place of this kind of knowledge, on account of its commanding importance both to the individual and to the community. We think that every man of even a moderate amount of education should have acquired a sufficient knowledge of these sub-

[1] From *Nature*.

jects to enable him at any rate to appreciate their value, and to take an interest in their progress and application to human life.

He points out that it is only in the last hundred years that the dogma of compulsory Greek and the value of what is now called a classical education has been promulgated. Previously, Latin was learnt because all the results of the studies of natural philosophers were in that language.

It is evident that Professor Lankester includes in his study of nature the study of intellectual and emotional man through history, biography, novels and poetry, but we think that he made a tactical mistake when he neglected to state this clearly. It seems to us that besides the study of nature, the most important thing in a child's education is to make him fond of reading in his own language, for this leads to a future power to make use of books and self-education for the rest of his life. When Professor Lankester doubts the value of the study of history he is evidently doubting the value of that study as carried on at Oxford, and surely no person who has read the scathing criticism of Professor Firth will disagree with him. When he speaks of a reform being possible, it may be that he is taking into account a movement of which but little is known outside Oxford itself, the growing indignation of the average undergraduate at being made to pay extravagant sums of money for tuition which is mischievous.

The readers of *Nature* are well acquainted with the views put forward in this address. Huxley and many others, dwelling, perhaps, more upon material loss to our empire, have published them over and over again, but we do not think that anybody has ever presented them with so much grace of style or so much of an endeavor to secure the good-will of his audience as Professor Lankester. But, alas! we fear that this fine address will share the fate of many others!

When, thirty-three years ago, Japan began her new career, there were a few people like Ito clever enough to see and say that the study of ancient classics alone, to the neglect of the study of nature, meant ruin to the country; but such ideas would never have been adopted had not Japan been in deadly peril. All the nations of Europe bullied and insulted her, and it was only their mutual jealousies which saved her from complete subjugation. In the presence of that peril the pedants held their peace, and everybody saw the necessity for an immediate, radical reform. In time nature was studied by every child in Japan, and in consequence scientific methods of thinking and acting have permeated the whole nation. All ancient and modern European literature is open to the Japanese who knows English, and English is the one language other than Japanese which every cultured man must know. In the matter of self-protection, any one can see the result. Because the Japanese have studied nature their scientific officers and men have marched or sailed to victory in every engagement; their statesmen will do exactly what is best for Japan in the negotiations for peace; their country will quietly take its place as one of the first-class powers of the world, and every person who knows anything about Japan is quite sure that ambitious, wrong-headed schemes of conquest are altogether impossible to the scientific minds of the Japanese.

If Japan had not been in great danger we know that she would not have taken to nature-study, and some of us think that it may need a state of danger in England to produce the necessary desire for reform. The South African muddle was worried through, and almost everybody seems to think that all such muddles may also be worried through, but some of us think that we may not always be so lucky. Danger is close enough even now, and we can only hope that if it becomes great it may grow slowly enough to let us learn something from the object-lesson which is being given us day by day in the news from Russia and the far east.

Fain would we hope that Oxford will pay attention to what has been said by one whom some of us regard as her cleverest son; but, alas! we have no such hope. Oh, Shade of Clough, how can we help saying that 'the

struggle naught availeth' when your own best admirers seem unable to think for themselves?

JOHN PERRY.

SCIENTIFIC NOTES AND NEWS.

DR. WILLIAM J. MAYO, surgeon of the St. Mary's Hospital, Rochester, Minn., has been elected president of the American Medical Association.

DR. WILLIAM H. NICHOLS, of New York, gave the presidential address before the Society of Chemical Industry at its general meeting in London on July 10. Dr. Edward Divers, F.R.S., was elected president of the society for the ensuing year.

FREDERIC S. LEE, PH.D., professor of physiology in Columbia University; Martin H. Fischer, Ph.D., assistant professor of physiology in the University of California, and George T. Kemp, Ph.D., professor of physiology in the University of Illinois, have been elected associate members of the American Medical Association.

THE *Révue de médecine et d'hygiene tropicales* announces that Dr. Ch. Wardell Stiles, of the Public Health and Marine Hospital Service, has been elected an honorary member of the Société de Médecine et d'Hygiène Tropicales of Paris, France.

DR. GEORGE T. MOORE, physiologist and algologist, in charge of the laboratory of plant physiology of the Department of Agriculture, has resigned.

DR. GISBERT KAPP, who has accepted a professorship in electrical engineering at the University of Birmingham, has resigned as general secretary of the German Association of Electrical Engineers and as editor of the *Elektrotechnische Zeitschrift*. His successor as general secretary is Dr. Georg Dettmar, and his successor as editor of the *Elektrotechnische Zeitschrift* is Dr. E. C. Zehme.

WE learn from the *Bulletin of the American Mathematical Society* that Professor H. Taber, of Clark University; Professor H. F. Blichfeldt, of Stanford University, and Professor W. D. Cairns, of Oberlin College, will spend next year at European universities.

M. M. J. DYBOWSKI, French inspector general of agriculture for the colonies, has been made an officer of the French legion of honor.

ON the occasion of the recent celebration of the fourth centenary of the Royal College of Surgeons, Edinburgh, the honorary fellowship of the college was conferred upon the following: Professors Anton, Freiherr von Eiselberg and Ernst Fuchs, Vienna; Professor Sylvester Saxtough, Copenhagen; Professor Felix Guyon Just Lucas Camponnière, Paul Segond and Louis Felix Terrier, Paris; Professor à Poucet, Lyons; Professors Ernst von Bergmann and Franz König, Berlin; Professor August Bier, Bonn; Professor Vincenz Czerny, Heidelberg; Professor Francesco Duranti, Rome; Baron Yosuzumi Saneyoshi, Japanese navy; Maxim Semenovic Subbotin, chief of the surgical clinic, Military Hospital, St. Petersburg; Professor Lennauder, Upsala; Professor Kronlein, Zürich; Professors William Stewart Halstead and Howard Kelly, Baltimore; Professor Keen, Philadelphia; Dr. William J. Mayo, Minnesota; Professor Charles McBurney, Columbia University, and Professor J. C. Warren, Harvard University.

AT the recent commencement of Amherst College the degree of master of arts was conferred by President Harris on Mr. Lundin. He said: "Carl Axel Robert Lundin, scientific expert in cutting and fashioning glasses of great telescopes. He has done important work on the large objectives of Russia, of the Lick and Yerkes observatories, and lately on the 18-inch objective of the Amherst College observatory, which is wholly his work. In 1854 Amherst conferred the degree of master of arts on Alvan Clark, who had built our first telescope. The same degree, for a similar service, is conferred on his successor, who has kept pace with the progress of astronomical science."

THE seventieth birthday of Professor G. Merkel was celebrated at Nuremberg, on June 29. He was presented with a *Festschrift*, and with a portrait bust by his former students and the Erlangen medical faculty.

DR. SWALE VINCENT, Winnipeg, professor of physiology in the medical faculty of the

University of Manitoba, has been invited by the University of London to deliver a course of lectures on 'The Ductless Glands.'

The American Medical Association has taken steps for the erection of a suitable memorial to Dr. N. S. Davis, who is regarded as the founder of the association.

The committee appointed on March 25, 1873, to consider the steps to be taken to raise a memorial at Cambridge to the late Professor Sedgwick has issued a final balance-sheet with a list of subscribers. The receipts were: Subscriptions for the building, £10,651 0s. 6d.; for the statue of the professor, £506 1s.; interest on deposit, £811 19s. 10d.; dividends, £13,714 1s. 3d.; profit on sale of investments, £1,769 19s. 9d.; total, £27,453 2s. 4d. The payments were: Printing, advertising, etc., £186 14s. 7d.; university for the building, £26,125; Mr. Onslow Ford for statue, £1,050; balance in hand, £91 7s. 9d., which has been paid over to the university financial board.

A tablet was unveiled on July 14, by Signor G. Marconi, on the house in which Sir Humphry Davy once lived at Clifton, Bristol.

Dr. J. Latchenberg, professor of physiology in the veterinary school of Vienna, died on June 21, at the age of fifty-seven years.

The death is announced of Mr. Charles Moore, director of the Sydney Botanical Gardens, at the age of eighty-six years.

There will be civil service examination on August 16 and 17 to fill the position of physical chemist in the government laboratories at Manila, at a salary of $1,800 a year.

Owing to the occurrence of several cases of hydrophobia in Penang, four of which have already ended in death, Leong Fee, the Chinese consul, has made an offer to the British government to build and equip a Pasteur institute for the Straits Settlements and the neighboring regions.

Dr. E. G. Gade has presented his native city of Bergen, Norway, with $30,000 to equip and support a laboratory for pathologic anatomy.

The Bressa prize of the Turin Academy of Sciences will be awarded at the end of the present year for the most important work in the science during the preceding three years. The value of this prize is about $2,000.

Despatches to the daily papers state that German astronomers are making unusual preparations for the observation of the forthcoming total eclipse of the sun. The Hamburg Observatory will send an expedition to Algiers, which will take an extensive series of observations, giving special attention to electrical phenomena. Photographs of the sky adjacent to the sun will be taken in the hope of discovering a planet within the orbit of Mercury. The observatories at Potsdam and Göttingen will send astronomers to Spain and Algiers for observations. The Prussian Meteorological Observatory at Potsdam is sending an expedition to Burgos, Spain, to study atmospheric and electrical phenomena the week before and the week after the eclipse.

At the meeting of the International Zoological Congress, to be held in Boston in 1907 under the presidency of Mr. Alexander Agassiz, the prize founded by Emperor Nicholas II. will be awarded. The subject is new experimental researches on hybrids. The researches which may be in manuscript or printed after this announcement must be sent before June 1, 1907, to Professor R. Blanchard, Boulevard St. Germain, 226. The papers must, it appears, be written in French, or be accompanied by an abstract in French.

There were about 600 botanists present at the International Congress held at Vienna, from June 11 to 18. The third congress will be held at Brussels in 1910.

In connection with the present visit of the British Association to Rhodesia, the British South African Company have issued a special set of postage stamps, the design on which represents a view of the Victoria Falls. This issue will also serve to commemorate the formal opening, during the British Association's visit to the falls, of the bridge across the Zambesi River, one of the greatest engineering marvels of modern times, and a most important link in the Cape to Cairo railway.

The American Medical Association will meet next year at Boston at a time to be sub-

sequently determined. At the recent Portland meeting there was an attendance of 1,714 members. The association authorized the publication of a medical directory of the country and the purchase as the basis for it of the 'Standard Directory.' This national medical directory is to contain an abbreviated biography of all physicians of the United States. Among other topics taken up by the house of delegates was the exclusion of advertisements of nostrums from the journal of the association and the question of incorporation by congress. The American Medical Association has a large budget, especially in connection with its weekly journal, the publication expenses last year amounting to $181,298.

A MEETING was held at Toronto, on July 13, for the purpose of extending a formal invitation to the British Medical Association to meet in Toronto in 1906, indorsing the action of the Canadian Medical Association. Mr. I. H. Cameron was delegated to present this invitation at the approaching meeting of the association.

THE fourteenth International Congress of Americanists will be held at Quebec from September 10 to 15, 1906. Dr. Robert Bell, director of the Geological Survey of Canada, is president, and Dr. N. E. Dionne, librarian of the Legislative Assembly, Quebec, is secretary. The work of the congress will have reference to: (*a*) The native races of America, their origin, geographical distribution, history, physical characters, languages, civilization, mythology, religions, morals and habits. (*b*) The indigenous monuments and the archeology of America. (*c*) The history of the discovery and European occupancy of the New World. The meetings of the congress will take place in the legislative building. Details pertaining to receptions, entertainments and excursions will be given in a later announcement. It is probable, however, that after the close of the sessions of the congress, an excursion to Lake St. John, including a visit to a camp of Montagnais Indians of the region, will be organized. Excursions in the neighborhood of Quebec will be made during the week of the congress.

A PRELIMINARY program has been issued for the next International Medical Congress that will be held at Lisbon from April 19 to 26, 1906.

The Experiment Station Record states that an act recently passed by the state legislature of Massachusetts makes provision for the appointment of a superintendent for suppressing the gypsy and brown-tail moths, and outlines the duties of cities and towns in that connection and the conditions under which they may be reimbursed in part for the expense of suppression. The bill appropriates $300,000, of which $75,000 may be expended during the calendar year 1905, $150,000 during 1906, and the remaining $75,000, with any unexpended balances, up to May 1, 1907. An additional sum of $10,000 in each of the three years may be expended for experiments with parasites or natural enemies for destroying these moths. A. H. Kirkland, a graduate of the Massachusetts Agricultural College, and formerly connected with the gypsy-moth work of the state, has been appointed superintendent at a salary of $5,000 a year.

ACCORDING to an abstract in the *Geographical Magazine* the report for 1903–4 of the New Zealand Lands and Survey Department shows satisfactory progress in the way of mapping and defining areas and of the appropriation of the land. There were, in 1903–4, 2,813 new selections comprising over 1½ million areas, an increase of 35,279 on the area of land selected in 1902–3; 432 of the selections were less than 1 acre each, and 166 reached 1,000 acres and upwards, the average selection measuring 577 acres. Under the Village Settlement system there were, on March 31, 1904, 2,014 settlers holding 43,146 acres, an average of 21¼ acres each. In view of the great shrinkage of land inviting settlement and other drawbacks, the record of land operations must be accounted satisfactory. The gross total of milling timber on Crown lands is estimated at 21,000 million superficial feet, Nelson district heading the list with a volume of about 6,000 million superficial feet of all varieties, closely followed in order by Westland and Wellington. The Crown kauri timber in Auckland is found

to be below former estimates, and as there are about thirty-six kauri mills clearing 144 million superficial feet per annum, in eight years the colony's supply of kauri would be exhausted. However, the timber of the rimu, matai and totara forests in the north is now found far in excess of previous computations. The output of all the mills in the colony is estimated at 372 million superficial feet per annum, a rate which would clear away all the colony's timber in seventy years. On the other hand, over 6¼ million trees were raised in the nurseries and plantations in 1903–4 as against 4 million in 1902–3. The total number of trees raised between 1896 and 1904, on an area now measuring 1,040½ acres, was 18,293,682. The prison-labor applied to tree-planting has proved every way profitable, notably in a moral sense, to the prisoners. The weight allowed to the claims of natural beauty may be gathered from the assignment of ample areas as scenic reserves. More particularly, in the highly picturesque south land it is proposed to preserve in native immunity no less than 2,772,440 acres, including the Sounds National Park of 2,500,000 acres. During 1903–4 triangulation continued more or less in abeyance owing to settlement requirements, but the surveyor-general urges the resumption of triangulation on a large scale. A full report of the magnetic work of the year is furnished by Mr. Skey. Particularly interesting is the reference to the joint work of the Hagley Park observatory and the Antarctic Expedition. Eight photographs of the most marked seismograms of the year are appended. In the northern part of the South Island magnetic work has been suspended since February, 1904. A further three months' work by one officer is all that is now needed to complete the magnetic survey of the colony, the results of which would be of so great value as well to navigation as to pure science. The comprehensive report deals also with temperature, rainfall, sanctuaries for animals and birds, etc. Besides maps and plans, there are numerous illustrations of scenery, flora, fauna, etc. The report of the minister of railways shows the railway mileage of New Zealand as 2,328.

UNIVERSITY AND EDUCATIONAL NEWS.

The cornerstone has been laid of the new engineering building of the University of Iowa, which is to be erected at a cost of $600,000.

The contract has been awarded for a new bacteriological building at the University of Minnesota. It will be built at once and will cost $100,000.

Mr. Simon Guggenheim has given $75,000 to the Colorado School of Mines at Denver. It will be used for the erection of an administration building.

The university benefaction fund for Cambridge University now amounts to about $400,000. The largest gift during the past year is one of $25,000 from Lord Rayleigh.

The Bates College corporation will ask from the Maine legislature a repeal of the charter which provides that the president of Bates College and a majority of the board of fellows and of the board of overseers shall be members of some church in the Free Baptist denomination. It is understood that this action is taken in order that the college may take advantage of the pensions of the Carnegie Foundation.

Two new fellowships have been created in the department of chemistry, Ohio State University, Columbus, Ohio. The holders of the fellowships will receive free tuition and $300. Applicants should apply at once to Professor William McPherson, Columbus, Ohio.

The council of the University of Liverpool has instituted a lectureship in experimental psychology. The work in psychology will, for the present, be carried on in the physiological laboratory.

Professor H. S. White, of Northwestern University, has been appointed professor of mathematics at Vassar College.

Mr. W. H. Watkinson, of the Glasgow and West of Scotland Technical College, has been appointed professor of engineering at the University of Liverpool.